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Pagano et al.

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[45] **Date of Patent: Oct. 19, 1999**

[54] **FILM SLIDE AND FILM EXTRACTOR**

[75] Inventors: **Daniel M. Pagano**; **Dale F. McIntyre**, both of Honeoye Falls; **David L. Patton**, Webster; **Edward Weissberger**, Pittsford, all of N.Y.

[73] Assignee: **Eastman Kodak Company**, Rochester, N.Y.

[21] Appl. No.: **08/896,841**

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[51] **Int. Cl.**[6] **B23P 19/00**

[52] **U.S. Cl.** **29/426.3**; 29/426.5; 29/700; 29/DIG. 105; 40/709

[58] **Field of Search** ..... 29/426.1, 426.3, 29/426.5, 700, DIG. 95, DIG. 105; 242/600; 396/397, 440; 40/701, 705, 709, 775

[56] **References Cited**

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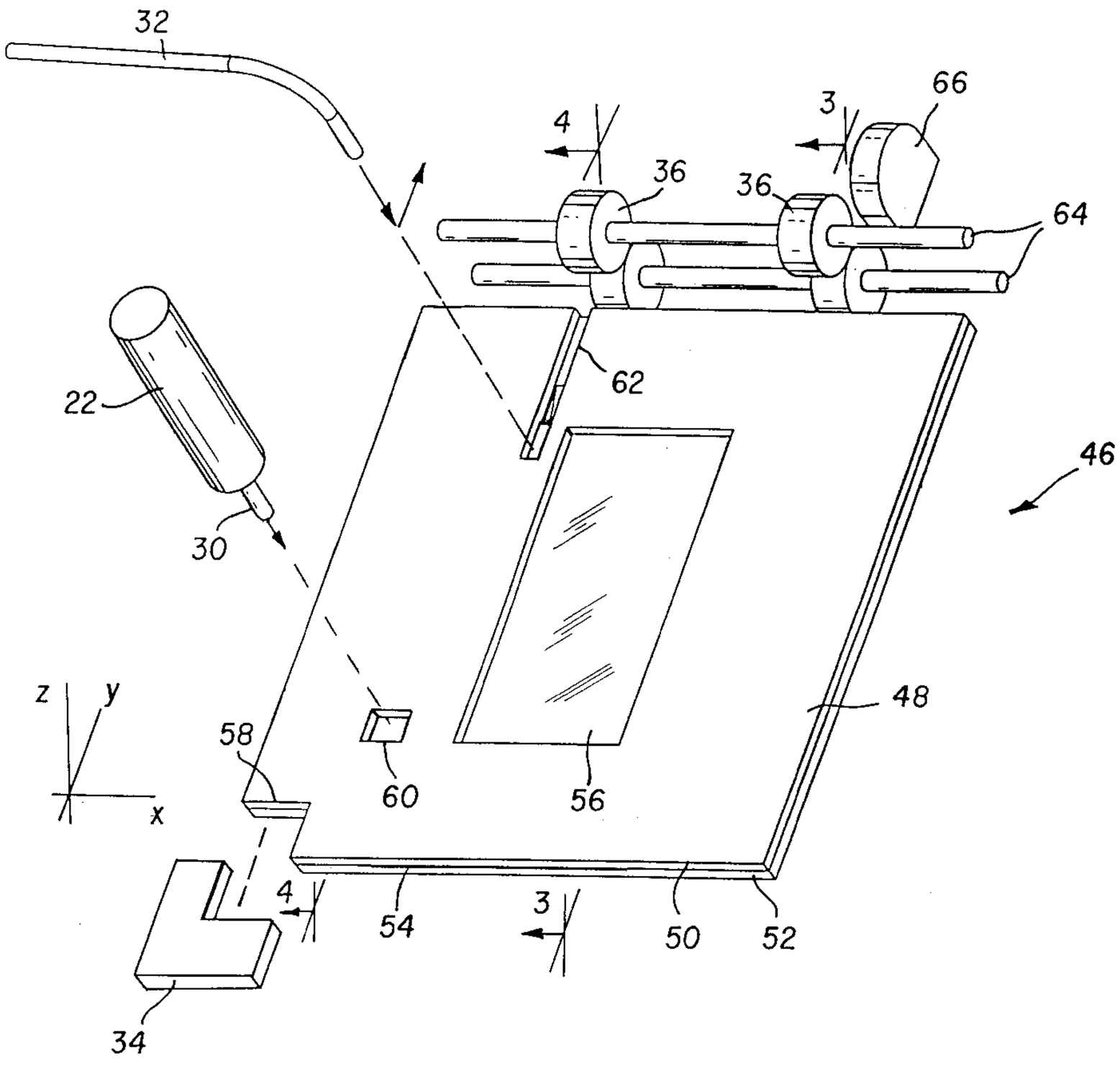
Primary Examiner—P. W. Echols
Assistant Examiner—John Hong
Attorney, Agent, or Firm—Robert Luke Walker

[57] **ABSTRACT**

A slide mount has a first portion and a second portion. The first portion includes an interior region, an edge, and a slot extending from the interior region to the edge. A cavity is formed between the first portion and the second portion, and extends to the first edge, with a film segment in the cavity extracted therefrom by a film extraction system. The film extraction system includes a piston for disengaging a latch mechanism from the film segment. An extractor arm enters the slot to engage a second perforation in the film segment, and slidably moves within the slot to move the film segment through and out of the cavity toward a roller. The film extraction system operates with the slide mount according to a method including the steps of: extending the piston into a locking aperture in the slide mount; disengaging a latch end from a first perforation in the film segment; extending the extractor arm into the extraction slot; engaging a second perforation in the film segment with the extractor arm; and moving the extractor arm through extraction slot to move the film segment out of the cavity.

13 Claims, 9 Drawing Sheets



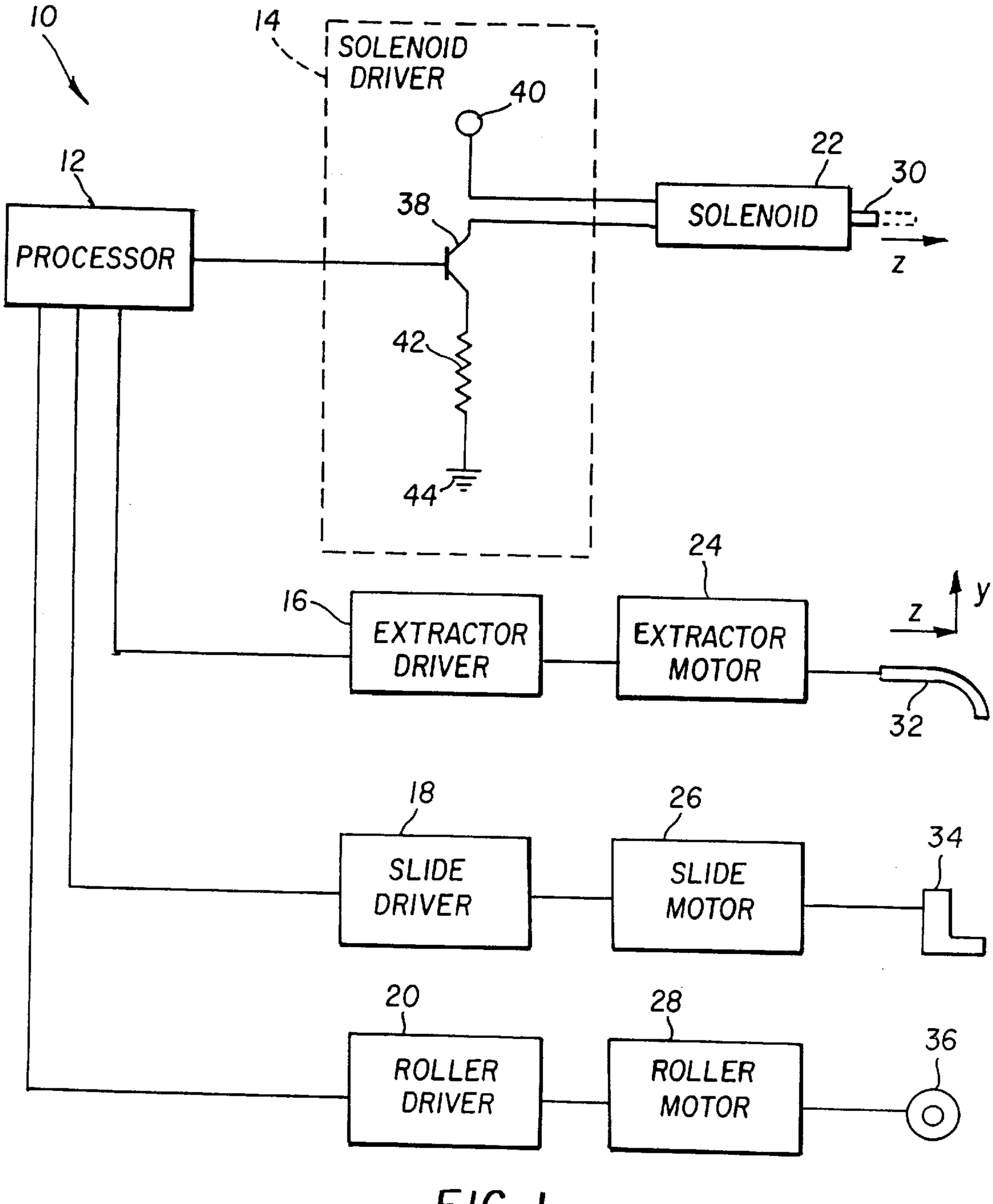

10
14
SOLENOID DRIVER
40
12
22
30
38
PROCESSOR
SOLENOID
z
42
44
24
16
EXTRACTOR DRIVER
EXTRACTOR MOTOR
z
y
32
18
26
34
SLIDE DRIVER
SLIDE MOTOR
20
28
36
ROLLER DRIVER
ROLLER MOTOR

FIG. 1

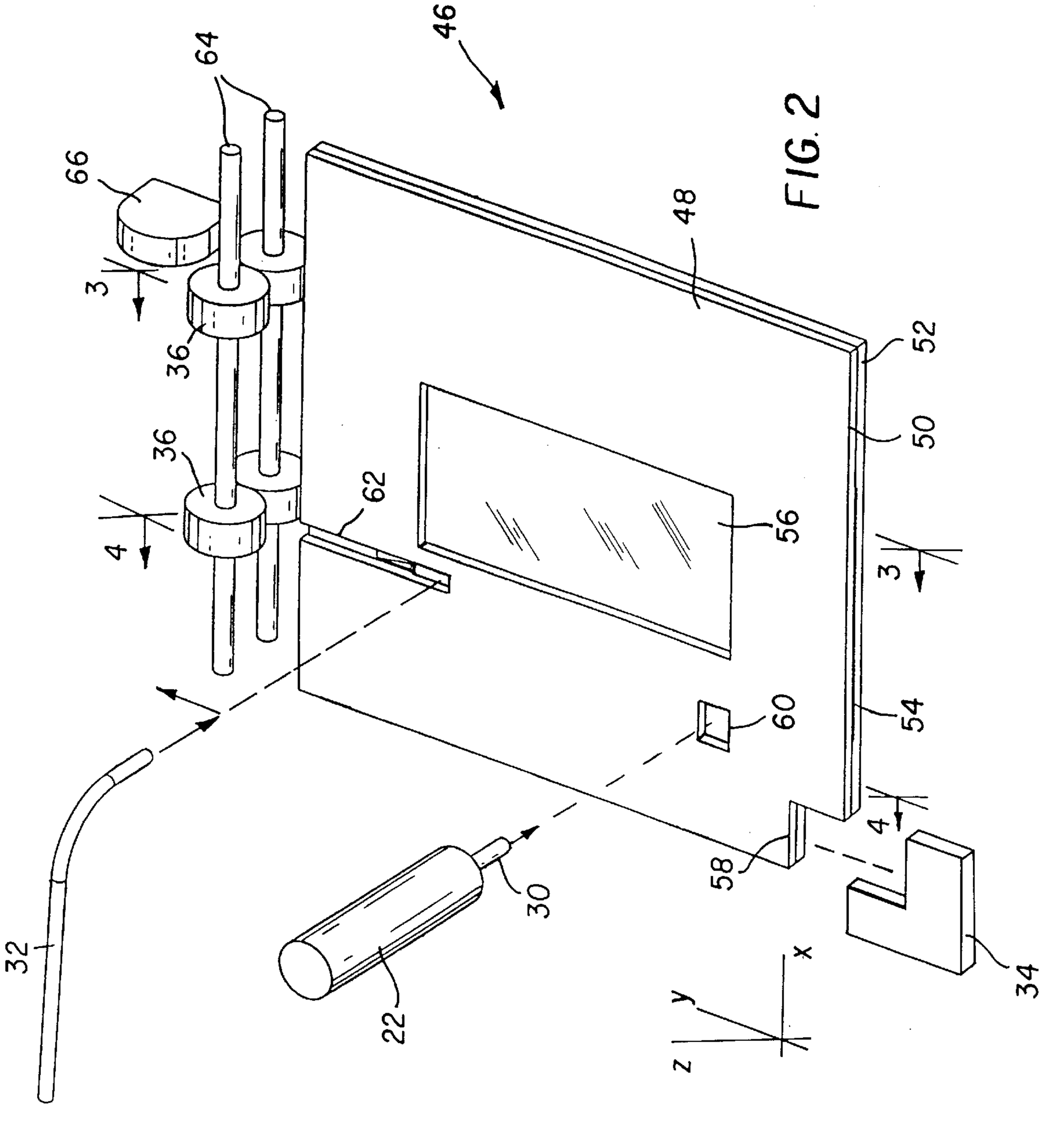


FIG. 2

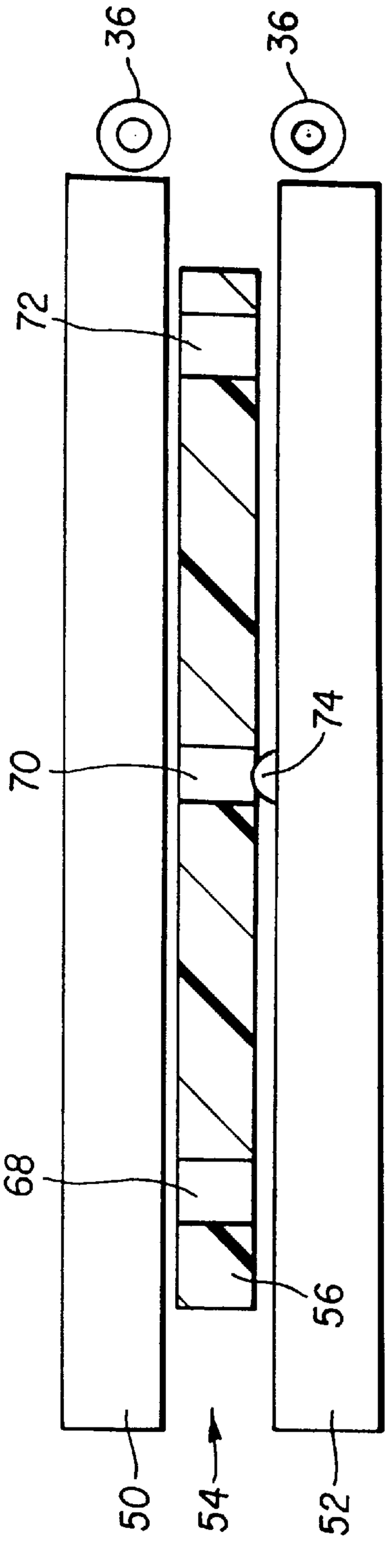


FIG. 3

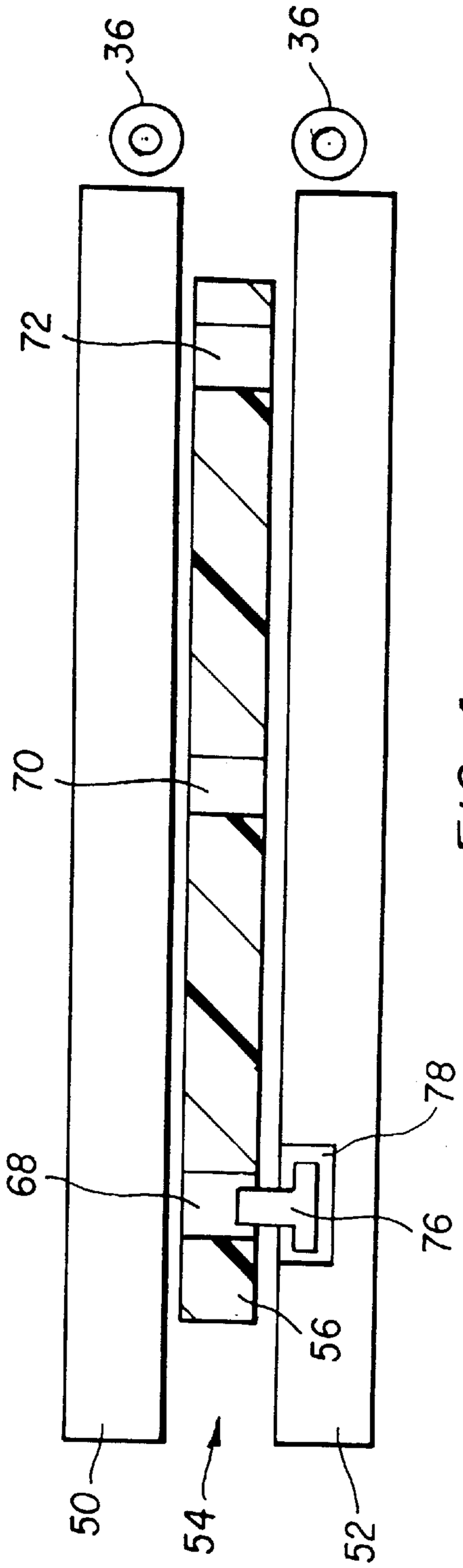


FIG. 4

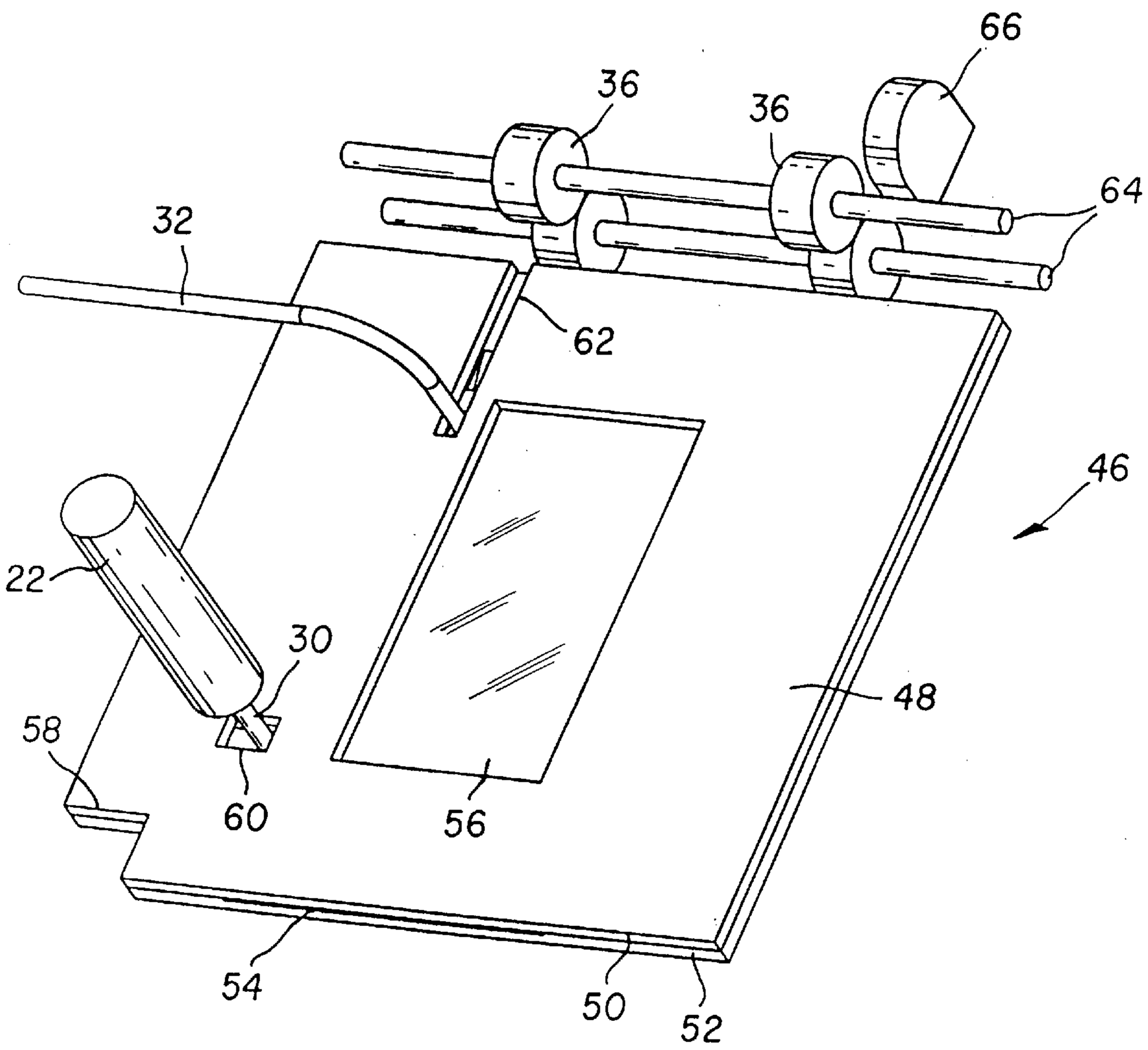


FIG. 5

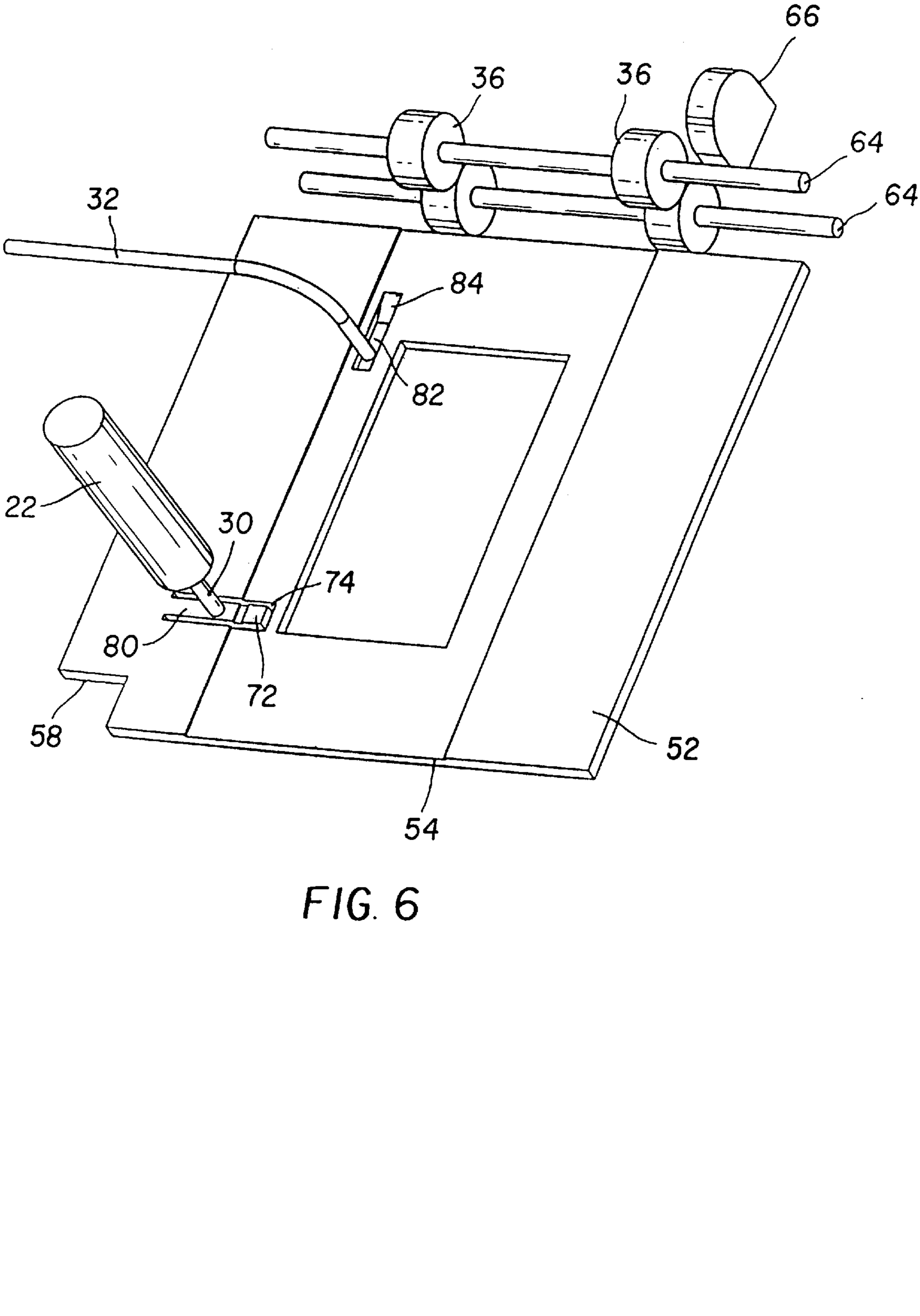


FIG. 6

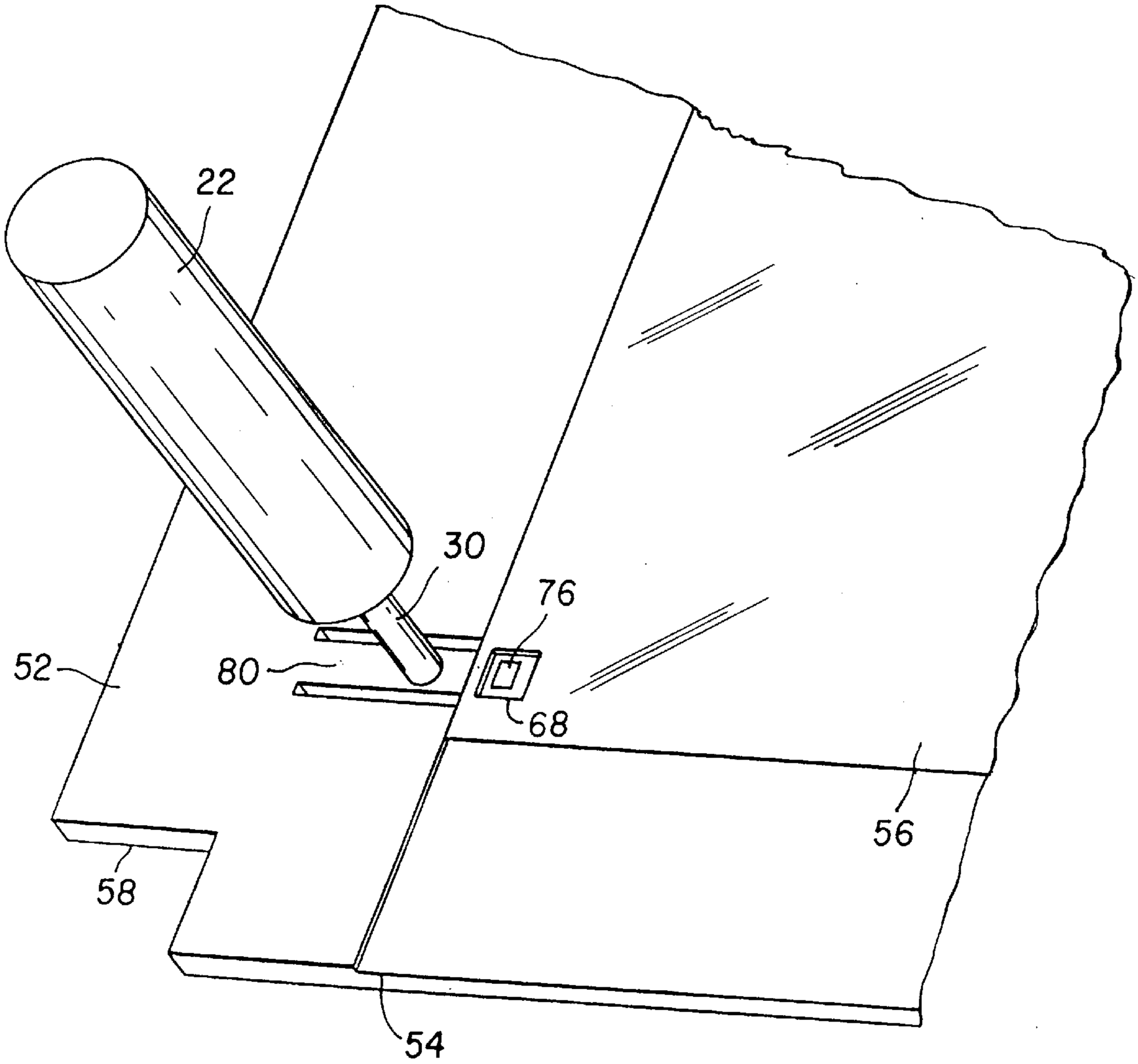


FIG. 7

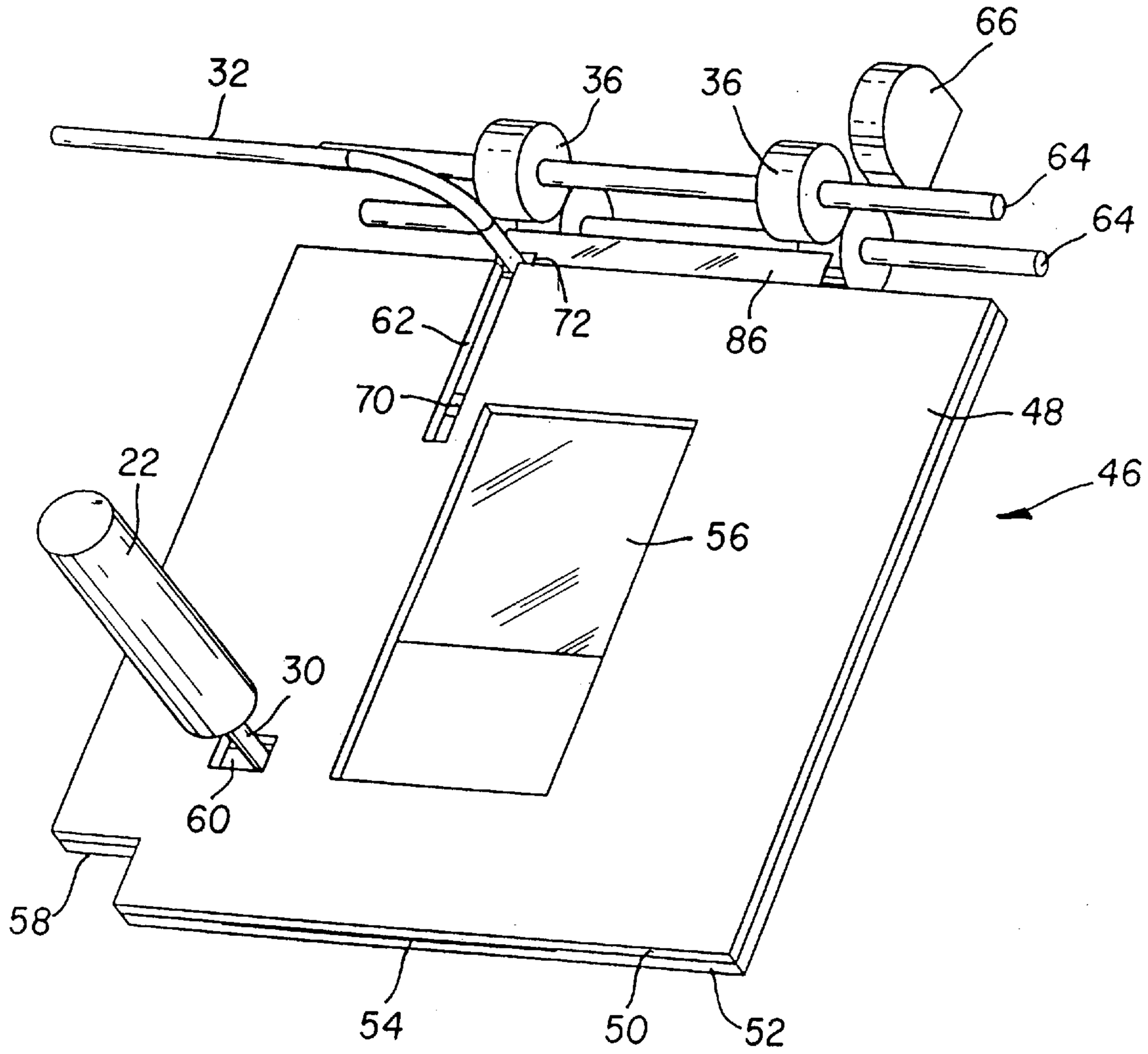


FIG. 8

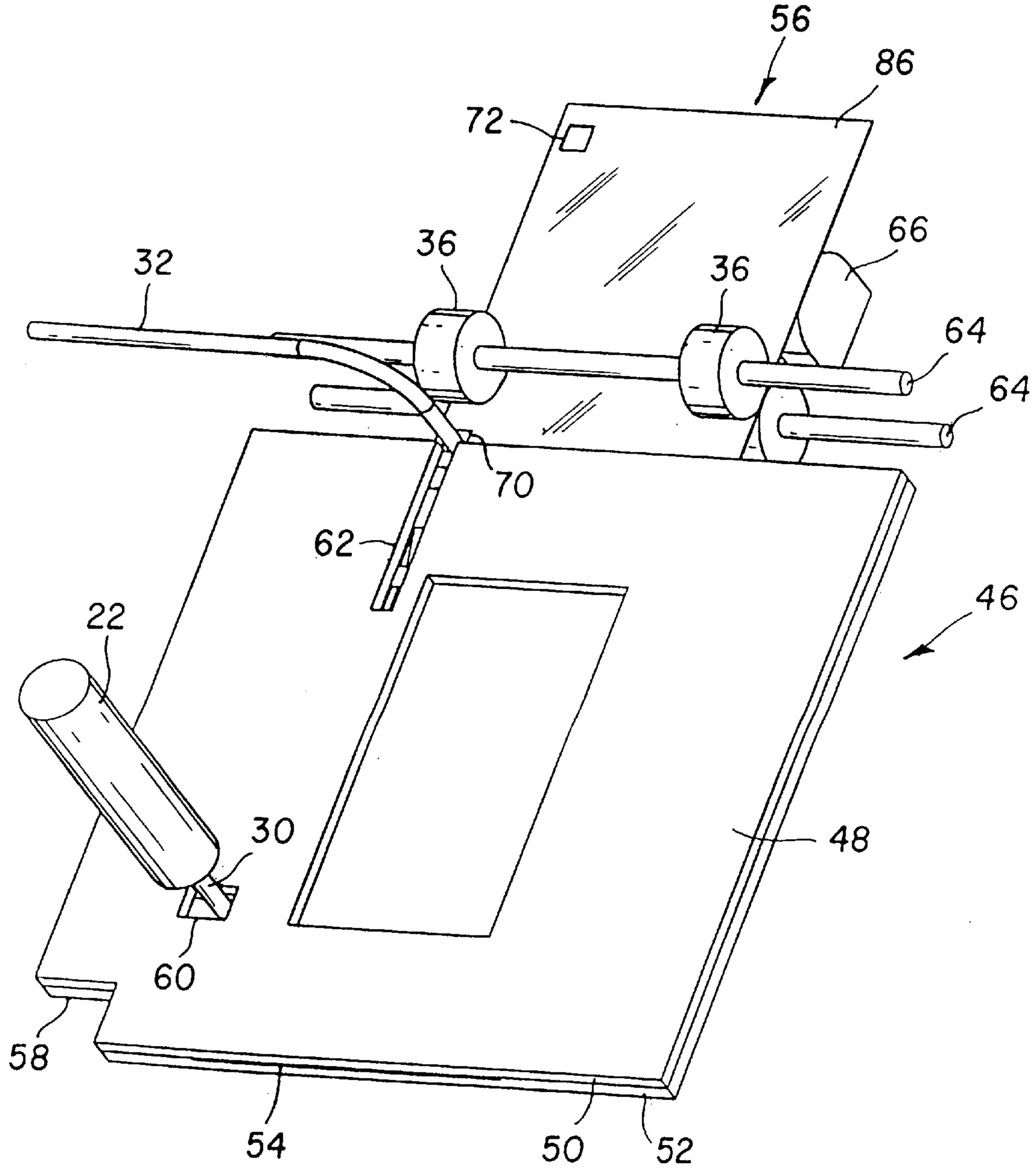


FIG. 9

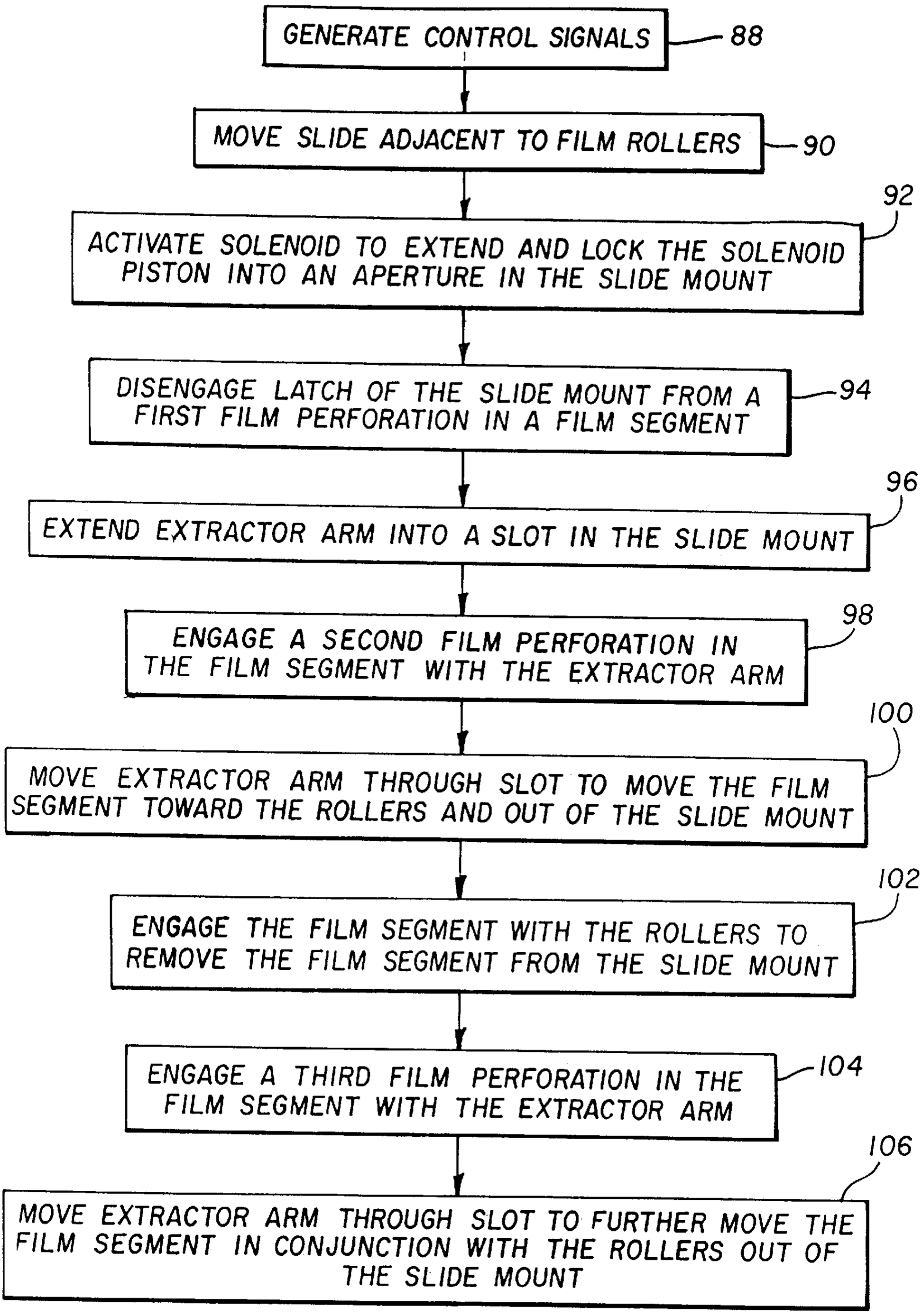

GENERATE CONTROL SIGNALS
88
MOVE SLIDE ADJACENT TO FILM ROLLERS
90
92
ACTIVATE SOLENOID TO EXTEND AND LOCK THE SOLENOID PISTON INTO AN APERTURE IN THE SLIDE MOUNT
DISENGAGE LATCH OF THE SLIDE MOUNT FROM A FIRST FILM PERFORATION IN A FILM SEGMENT
94
96
EXTEND EXTRACTOR ARM INTO A SLOT IN THE SLIDE MOUNT
ENGAGE A SECOND FILM PERFORATION IN THE FILM SEGMENT WITH THE EXTRACTOR ARM
98
100
MOVE EXTRACTOR ARM THROUGH SLOT TO MOVE THE FILM SEGMENT TOWARD THE ROLLERS AND OUT OF THE SLIDE MOUNT
102
ENGAGE THE FILM SEGMENT WITH THE ROLLERS TO REMOVE THE FILM SEGMENT FROM THE SLIDE MOUNT
ENGAGE A THIRD FILM PERFORATION IN THE FILM SEGMENT WITH THE EXTRACTOR ARM
104
106
MOVE EXTRACTOR ARM THROUGH SLOT TO FURTHER MOVE THE FILM SEGMENT IN CONJUNCTION WITH THE ROLLERS OUT OF THE SLIDE MOUNT

FIG. 10

FILM SLIDE AND FILM EXTRACTOR

CROSS REFERENCE TO RELATED APPLICATIONS

Reference is made to commonly assigned U.S. patent applications Ser. No. 08/775,677 now U.S. Pat. No. 5,743,609 entitled: METHOD AND APPARATUS FOR PREPARING PHOTOGRAPHIC FILM UNITS HAVING IMAGE FRAME ASSOCIATED ENCODED INFORMATION, and filed in the names of Richard Bauer, Dale McIntyre, Daniel Pagano, David Patton, and Edward Weissberger; Ser. No. 08/775,326, now U.S. Pat. No. 5,743,615 entitled: FILM SLIDES HAVING ENCODED DATA AND METHODS FOR PREPARING FILM SLIDES, and filed in the names of Dale McIntyre, Daniel Pagano, David Patton, and Edward Weissberger; Ser. No. 08/775,814, now U.S. Pat. No. 5,751,399 entitled: FILM SLIDES HAVING DATA WINDOWS, and filed in the names of Dale McIntyre, Daniel Pagano, David Patton, and Edward Weissberger; Ser. No. 08/775,321, now U.S. Pat. No. 5,803,565 entitled: ORIENTING PROJECTOR, and filed in the names of Dale McIntyre, Daniel Pagano, David Patton, and Edward Weissberger; Ser. No. 08/775,816, now U.S. Pat. No. 5,738,428 entitled: FORMATTING PROJECTOR, and filed in the names of Dale McIntyre, Daniel Pagano, David Patton, and Edward Weissberger; Ser. No. 08/775,847, entitled: ANNOTATION DISPLAYING PROJECTOR, and filed in the names of Dale McIntyre, Daniel Pagano, David Patton, and Edward Weissberger; Ser. No. 08,896,374 now U.S. Pat. No. 5,837,079 entitled: FILM ORIENTING SLIDE MOUNTER AND METHOD, and filed in the names of David Patton, Daniel Pagano, Dale McIntyre, and Edward Weissberger; Ser. No. 08/897,169 entitled: DEFINED ORIENTATION SLIDE PROJECTOR AND SLIDES, and filed in the names of Daniel Pagano, David Patton, Dale McIntyre, and Edward Weissberger; Ser. No. 08/897,171 entitled: FILM SEGMENT PRINTING SYSTEM AND METHOD, and filed in the names of David Patton, Daniel Pagano, Dale McIntyre, and Edward Weissberger; Ser. No. 08/896,844 entitled: SLIDE WITH MAGNETIC MARKS THAT CAN BE READ BY MULTIPLE HEADS, and filed in the names of Dale McIntyre, Daniel Pagano, David Patton, and Edward Weissberger; each of which are assigned to the assignee of this application.

FIELD OF THE INVENTION

This invention relates generally to the field of film slides, and in particular to film slide extractors and film slides for the extraction of film segments, as well as methods for extracting film segments from film slides using film slide extractors.

BACKGROUND OF THE INVENTION

Film slides are convenient devices for mounting film segments storing images for projection and display. Some prior art film slides and other film mounting apparatus mount film segments permanently in a frame or slide mount. Other apparatus, such as described in U.S. Pat. Nos. 3,530,608; 3,581,422; and 5,392,548 are examples of apparatus for mounting and dismounting film with respect to the frame or slide mount.

Heretofore, once a film segment was mounted, the dismounting of such film segments for replacement, for cataloging, for repair, etc. was performed manually. However, manual dismounting is ill-adapted to high speed film handling systems, since the film mounting apparatus must be manually dismantled, and the film segment then manually removed for subsequent handling.

Further, such dismantling may warp, damage, or destroy the film mounting apparatus, so it cannot be used further.

In addition, after manual removal, it is incumbent upon the person removing the film segment to accurately position the removed film segment in a proper orientation for later handling of the film segment. Such manual operations are fraught with difficulties; in particular, manual operations may have error rates which are reduced, for example, by increasing handling time per film segment to ensure accuracy. Such error reduction techniques therefore result in slow handling rates.

Accordingly, a need exists for a film slide adapted for easy dismounting of the film segment therein without damage to the film slide. In addition, a need exists for a film slide dismounting system and method for high speed and highly accurate removal and handling of film segments.

SUMMARY OF THE INVENTION

It is recognized herein that a film slide may be constructed which permits relatively easy dismounting of the film segment therefrom without damage to the film slide. In addition, an automated film slide dismounting system and method is provided which may be operated at relatively high speed and with highly accurate removal and handling of film segments in high volume film handling applications.

A slide mount is disclosed having a first portion and a second portion adjacent to the first portion. The first portion includes an interior region, an edge, and a slot extending from the interior region to the edge. At least one of the first and second portions form a cavity between the first and second portions extending to at least the edge, and the cavity is dimensioned for positioning a film segment therein so as to permit relatively easy extraction of the film segment therefrom.

The slide mount is used in a film extraction system which includes a piston for contacting a latch mechanism to disengage it from the film segment, and an extractor arm for entering the slot to engage a perforation in the film segment, and for slidably engaging the slot so as to move the film segment through the cavity in the direction of the edge of the slide mount so it exits the cavity. The film extraction system operates with the slide mount according to a method including the steps of: (a) extending a piston into a locking aperture in the slide mount, (b) disengaging a latch end from a first perforation in the film segment, (c) extending an extractor arm into an extraction slot in the slide mount, (d) engaging a second perforation in the film segment with the extractor arm, and (e) moving the extractor arm through the extraction slot to move the film segment out of the slide mount.

BRIEF DESCRIPTION OF THE DRAWINGS

The features and advantages of the present invention will be readily apparent, and are to be understood, by referring to the following detailed description of the preferred embodiments of the present invention, taken in conjunction with the accompanying drawings, in which:

FIG. **1** is a block diagram of the film extraction system;

FIG. **2** is a perspective view of a slide with the components of the film extraction system prior to extraction of a film segment;

FIG. **3** is a side cross-sectional view of the slide and film segment positioned therein along lines **3**—**3** of FIG. **2**;

FIG. **4** is a side cross-sectional view of the slide and film segment positioned therein along lines **4**—**4** of FIG. **2**;

FIG. **5** is a perspective view of the film extraction system initially engaging the slide and the film segment positioned therein;

FIG. **6** is a perspective view of the film extraction system engaging internally disposed elements of the slide;

FIG. **7** is a cut-away perspective view of the film extraction system disengaging a latch from a perforation of the film segment;

FIGS. **8** and **9** are perspective views of the film extraction system progressively extracting the film segment from the slide; and

FIG. **10** is a flowchart of the method of operation of the disclosed film extraction system.

DETAILED DESCRIPTION OF THE INVENTION

Referring in specific detail to the drawings, with common reference numbers identifying similar or identical elements, steps, and features, as shown in FIG. **1**, the present invention is directed to a film slide and a film extractor system **10**, and a method for using the slides and system **10** to extract a film segment from such a film slide. The film extraction system **10** includes a processor **12** operatively connected to a solenoid driver **14**, an extractor driver **16**, and optionally to a slide driver **18** and a roller driver **20**, each of which is connected to a solenoid **22**, an extractor motor **24**, a slide motor **26**, and a roller motor **28**, respectively.

The processor **12** generates control signals to selectively drive the drivers **14–20** to control the components **22–28**, respectively, so as to control various mechanical structures to present slides and associated slide mounts to devices for extracting film segments from the slides, and optionally for reading from or writing to magnetic tracks on the film segments. When driven by the solenoid driver **14**, the solenoid **22** extends or retracts a solenoid piston **30** a predetermined distance along the z-axis with respect to a reference system as shown in FIG. **2**. When driven by the extractor driver **16**, in an extraction mode, the extractor arm **32** when in an initial position first moves a first predetermined distance in a first direction along the z-axis, and then moves a second predetermined distance in a second direction along the y-axis. In a reset mode, the extractor arm **32** moves the first predetermined distance in an opposite direction to the first direction along the z-axis, and then moves the second predetermined distance in an opposite direction to the second direction along the y-axis to return to the initial position.

When driven by the slide driver **18**, a slide positioner **34** engages and positions a slide in a predetermined location relative to the solenoid **22**, the extractor arm **32**, and/or at least one roller **36**. When driven by the roller driver **20**, the roller **36** rotates about an axle in appropriate clockwise or counter-clockwise directions to take up a film segment from the slide, as described in greater detail below.

The processor **12** may perform as a central processing unit (CPU) of a film handling apparatus and also in conjunction with other computing systems. For example, the processor **12** may be a commercially available microprocessor and/or a microcontroller, such as the MC68HC05 microcontroller available from "MOTOROLA". By executing predetermined software and/or firmware routines, the processor **12** may operate the disclosed film extraction system **10** as an automated system with high accuracy and high handling rates for high volume film handling applications. The processor **12** generates the control signals on respective outputs or output ports, such as pins, with respective control signals being applied to respective drivers **14–20**.

As shown in FIG. **1**, the solenoid driver **14** may include a transistor **38** connected between a node **40** leading to an energy source and a resistor **42** connected to a ground **44**. A contact of the transistor **38**, such as a pin to the base of the transistor **38**, receives the control signals from an appropriate output port of the processor **12**. As shown in the illustrative embodiment in FIG. **1**, the transistor **38** may be bipolar power transistors having the control signals applied to respective bases for selectively applying energy to the solenoid **22**. The control signals thus control the switching state of the transistor **38**.

For example, in an ON or first operative state, the transistor **38** provides a relatively low resistance to the flow of current from the energy source through the solenoid **22** and the current limiting resistor **42** to the ground **44**. The flow of current through the solenoid **22** energizes the solenoid piston **30** to move along the z-axis between predetermined positions; for example, between an extended position and an retracted or rest position. Removal of the control signal from the solenoid driver **14** de-energizes the solenoid **22**. The solenoid **22** may be configured to have a pre-loaded spring force to return the solenoid piston **30** to an initial rest position when de-energized.

In operation, the solenoid **22** may extend the solenoid piston **30** for a predetermined time. In one embodiment, the solenoid **22** may implement the predetermined time of extension of the solenoid piston **30** using an internal timing circuit such as a resistor-capacitor (RC) circuit (not shown in FIG. **1**). In another embodiment, the predetermined time of extension of the solenoid piston **30** may be implemented by the software executed by the processor **12**; that is, the predetermined time is implemented by a clock internal to the processor **12** which initiates changes in the control signals applied to the solenoid driver **14**.

The solenoid **22** may operate in a toggling manner, such that a first activation pulse from the solenoid driver **14** causes the solenoid piston **30** to extend in the first direction along the z-axis, and locks the solenoid piston **30** into place in the extended position. A second activation pulse causes the solenoid piston **30** to retract in the direction opposite to the first direction along the z-axis to release the solenoid **22** from the locked extended position to return to the retracted position. Accordingly, the control signal output from the processor **12** to the solenoid driver **14** may be a pulse of a predetermined minimum duration, with the solenoid **22** responsive to such a minimum duration pulse to extend or retract the solenoid piston **30**. Alternatively, the solenoid **22** may operate in response to a rising edge and/or a falling edge of a control signal.

Also, the solenoid **22** may operate in a continuous manner; that is, the solenoid **22** may extend the solenoid piston **30** as long as a continuous control signal is applied to the solenoid driver **14**, and retract the piston **30** automatically if the continuous control signal is no long applied to the solenoid driver **14**. When the solenoid piston **30** is extended, the end of the piston **30** engages a molded release feature of a slide, as described below in conjunction with FIGS. **2–9**.

In the illustrative embodiment, the solenoid **22** is used to extend the piston **30**. Alternatively, other mechanisms may be used to extend the piston **30**; for example, a configuration of interactive gears, a stepper motor, an air cylinder, a configuration of cams, etc.

Each of the extractor driver **16**, the slide driver **18**, and the roller driver **20** may be configured in a manner similar or identical to the solenoid driver **14**. The extractor driver **16** drives the extractor motor **24**, which may be a stepper motor and/or a plurality of motors for causing the extractor arm **32**, starting in an initial position, to sequentially move along the z-axis and then along the x-axis, as described above in an extraction mode, and to sequentially move along the z-axis and then along the x-axis to return to the initial position in a reset mode.

In FIG. **2**, the components of the film extraction system **10** are illustrated in an initial position for extracting film from a slide **46**. The slide **46** includes a slide mount **48** having a first portion **50** and a second portion **52** which are configured to form a cavity **54** therebetween and extending from one end of the slide **46** to a diametrically opposite end. The cavity **54** is configured such that a film segment **56** may be positioned and optionally held within the cavity of the slide **46**. The slide **46** is configured to be gripped, held, and/or moved by the film extraction system **10** to a predetermined location for film extraction by, or in conjunction with, the rollers **36**. In a preferred embodiment, the slide **46** includes a cut-out region **58** for engaging the slide positioner **34** such that movement of the slide positioner **34** positions the slide **46** adjacent to the roller **36** to extract the film segment **56**, as described below.

The cavity **54** is configured to retain an "Advanced Photographic System" (APS) film segment. Alternatively, any other size film such as 35 mm film may be positioned in the cavity **54**. The use of film segments having magnetic material appropriately disposed thereon, such as APS film segments having a registration located at a predetermined distance from an edge of the APS film segment and the photographic image on the film segment, causes the film segments to be readily written upon magnetically by a magnetic writing head **66** as described below.

The slide **46** also includes a locking aperture **60** which engages the solenoid piston **30** in the extended mode. The extended solenoid piston **30** may be used to prevent movement of the slide **46** in the direction of the y-axis, for example, by friction, if any, with the film segment **56** as the film segment **56** is extracted from the slide **46** by movement thereof in the direction of the y-axis.

The slide **46** includes an extraction slot **62** in the first portion **50** of the slide mount **48**. The extractor arm **32** may enter and slidably engage the extraction slot **62** by aligning the end of the extractor arm **32** over the extraction slot **62**, and by movement of the extractor arm **32** in the direction of the z-axis. The extraction slot **62** extends from an interior region of the slide **46** to an edge of the slide **46** adjacent to the roller **36**, with the extraction slot **62** dimensioned to permit movement of the extractor arm **32** through the extraction slot **62** from the interior region to the edge of the slide **46**.

As described below, a plurality of rollers **36** may be used which, upon engaging an end of the film segment **56**, rotate in appropriate clockwise and counter-clockwise directions about a set of axles **64** mounted to a frame of the film extraction system **10** (not shown in FIG. **2**). The rotation of the rollers **36** about the axles **64** extracts the film segment **56** from the cavity **54** of the slide **46**. In addition, the rollers **36** may also be mounted to pass a predetermined portion of the film segment **56** having magnetic material disposed thereupon substantially near a magnetic writing head **66** for magnetically processing data to be read from or written to the magnetic material.

As shown in FIGS. **3** and **4**, the film segment **56** is positioned within the cavity **54** between the first portion **50** and the second portion **52** of the slide mount **48**. The film segment **56** typically stores images thereupon, and includes a plurality of perforations **68**, **70**, and **72** which may be longitudinally and generally linearly positioned along the length of the film segment **56** with regular and/or predetermined constant spacings therebetween. As shown in FIGS. **3** and **4**, the film segment **56** is disposed within the cavity **54** such that the plurality of perforations **68**, **70**, and **72** extend from one edge of the slide **46** to a diametrically opposite edge. For illustrative purposes, the film segment **56** shown in FIGS. **3** and **4** has three perforations, but it is understood that the film segment **56** may include only two perforations, or more than three perforations, and that the disclosed film extraction system **10** may operation to extract film segments of any number of perforations per film segment.

As shown in FIGS. **3** and **4**, the film segment **56** includes a first perforation **68**, a second perforation **72**, and a third perforation **70**. In a first embodiment shown in FIG. **3**, the film segment **56** may be held within the cavity **54** by at least one internally disposed protrusion **74** engaging at least one perforation, for example, the third perforation **70**. By frictional engagement with the protrusion **74**, the engaged third perforation **70** and thus the entire film segment **56** are prevented from longitudinal movement within the cavity **54**. In the first embodiment of the disclosed film extraction system **10**, the extended solenoid piston **30** locks and holds the slide mount **48** as the extractor arm **32** enters the extraction slot **62** as shown in FIG. **5**, engages the second perforation **72**, and moves the second perforation **72** and the film segment **56** by overcoming the frictional resistance between the protrusion **74** and the third perforation **70**.

The extractor arm **32**, the extraction slot **62**, and the perforations **68–72** are appropriately dimensioned so that the extractor arm **32** may enter and slidably engage the extraction slot **62**, and so that the end of the extractor arm **32** may enter and engage the perforations **68–72** to move the film segment **56** out of the cavity **54**. For example, the extraction slot **62** may be about 2 mm wide to permit at least the end of the extractor arm **32** to enter and move within the extraction slot **62**. In addition, the perforations **68–72** may be square, rectangular, or circular having a width of about 2 mm along the direction parallel to the longitudinal length of the film segment **56** in the cavity **54**. Accordingly, at least the extractor arm **32** may be less than about 2 mm; that is, less than the width of the extraction slot **62** and also less than the width of the perforations **68–72**.

Continuous movement of the extractor arm **32** through the extraction slot **62** extracts the film segment **56** from the cavity **54**, as shown in FIG. **8**. Subsequent contact of the film segment **56** with the rollers **36** allows the rollers **36** to contribute to, and then take over, extraction of the film segment **56** from the cavity **54** as shown in FIG. **9**. The extractor arm **32** may then disengage the second perforation **72**, and optionally engages the other perforations such as the perforations **68** and **70** to continue the extraction operation in conjunction with the rollers **36**.

In an alternative embodiment shown in FIG. **4**, the slide **46** may include a latch mechanism having a latch end **76**, as a element protruding into the cavity **54**, disposed within a latch indentation **78**, for example, in the second portion **52** of the slide mount **48**. The latch end **76** is configured to engage a perforation of the film segment **56**; for example, the latch mechanism having the latch end **76** may be positioned to engage the first perforation **68** of the film segment **56**.

To extract the film segment **56** held in the cavity **54** by the latch end **76**, the disclosed film extraction system **10** extends the solenoid piston **30** into the locking aperture **60**, as shown in FIG. **5**, which disengages the latch end **76** from the first perforation **68**. In addition, in the embodiment shown in FIG. **4**, the solenoid piston **30** may also engage the locking aperture **60** to prevent movement of the slide **46** in the direction of the y-axis, for example, by friction, if any, with the film segment **56** as the film segment **56** is extracted from the slide **46** by movement thereof in the direction of the y-axis.

Referring to FIGS. **6** and **7** in conjunction with FIG. **4**, the latching mechanism is shown in greater detail. The second portion **52** of the slide mount **48** is shown in FIG. **6** without the film segment **56**, and is shown in FIG. **7** with the film segment **56** disposed in the cavity **54**. The latching mechanism includes a resilient member **80** integral with the second portion **52** of the slide mount **48**, with the latch end **76** connected to the resilient member **80** having a hinge-like connection to the second portion **52**, and extending into the cavity **54**. The resilient member **80** is configured such that an intermediate portion thereof is substantially aligned with the locking aperture **60**. Pressure applied to the intermediate portion of the resilient member **80** by the solenoid piston **30** in the first direction along the z-axis. Such pressure actuates the latch mechanism by causing a fulcrum-like action of the resilient member **80** to move the latch end **76** out of the first perforation **68** and into the latch indentation **78**.

The film segment **56** is then free to move longitudinally through the cavity **54** upon engagement of the extractor arm **32** with other perforations of the film segment **56**, and subsequent movement of the extractor arm **32** and the engaged perforations through the cavity **54**, as shown in FIGS. **8** and **9**. It is understood that the latch mechanism may include other structure for providing resilience, such as a spring positioned under the latch end **76**.

Referring to FIG. **6**, the extraction slot **62** may also include a slot recess **82** in the second portion **52** of the slide mount **48**. The end of the extractor arm **32** may then extend through the extraction slot **62**, the second perforation **72**, and the slot recess **82** to provide relatively secure engagement of the extractor arm **32** with the perforations of the film segment **56** to efficiently extract the film segment **56**. A ramp **84** may be formed in the slot recess **82** at the end thereof which is closer to the rollers **36**. In response to a sloping engagement of the end of the extractor arm **32** with the ramp **84** as the extractor arm **32** moves toward the rollers **36**, the extractor arm **32** is caused to disengage the slot recess **82** as the second perforation **72** approaches the rollers **36**.

In an alternative embodiment, the extractor motor **24** may include a sensor or other mechanisms known in the art for sensing the engagement of the extractor arm **32** with the ramp **84**, and then for responding to such sensing by returning the extractor arm **32** to the initial position, as described above.

As shown in FIGS. **8** and **9**, as the end **86** of film segment **56** approaches and engages the rollers **36**, the rotation of the rollers **36** provides additional force to achieve extraction motion of the film segment **56** from the cavity **54**. In addition, once the rollers **36** engage the end **86** of the film segment **56**, the extractor arm **32** may fully disengage from the second perforation **72**, and optionally may engage other perforations such as the third perforation **70**, as shown in FIG. **9**, to further extract the film segment **56**. The rollers **36** may be controlled by the roller motor **28** to longitudinally pass a predetermined portion of the film segment **56** having magnetic material disposed thereupon (not shown in FIG. **9**) at an appropriate speed to be magnetically read and/or written to by the magnetic writing head **66**.

The extracted film segment **56** may then be handled by a film segment printing system and method, such as described in U.S. patent application Ser. No. 08/897,171 entitled: FILM SEGMENT PRINTING SYSTEM AND METHOD, and filed in the names of David Patton, Daniel Pagano, Dale McIntyre, and Edward Weissberger; which is incorporated herein by reference.

In use, the disclosed film extraction system **10** operates according to the method shown in FIG. **10**, including the steps of: generating (**88**) control signals using the processor **12** to control the drivers **14–20**; moving (**90**) the slide **46** adjacent to the rollers **36** using a slide positioner **34**; and activating (**92**) the solenoid **22** to extend and lock the solenoid piston **30** into the locking aperture **60** in the slide mount **48**. In performing step **90** or in a separate step, the method also positions the slide **46** to a position relative to the solenoid **22** and the extractor arm **32**, as shown in FIG. **2**, such that the piston **30** and the extractor arm **32** are substantially aligned with the locking aperture **60** and the slot **62**, respectively.

If the embodiment shown in FIGS. **4**, **6**, and **7** is implemented to secure the film segment **56** in the cavity **54**, the method includes the step of disengaging (**94**) a latch end **76** of the slide mount **48** from a first perforation **68** in the film segment **56**.

For all embodiments, the method then includes the steps of: extending (**96**) the extractor arm **32** into the extraction slot **62** in the slide mount **48**; engaging (**98**) a second perforation **72** in the film segment **56** with the extractor arm **32**; moving (**100**) the extractor arm **32** through extraction slot **62** to move the film segment **56** toward the rollers **36** and out of the slide mount **48**; and engaging (**102**) the film segment with the rollers **36** to remove the film segment **56** from the slide mount **48**. Optionally, the method may then include the steps of: engaging (**104**) at least a third film perforation in the film segment with the extractor arm **32**; and moving (**106**) the extractor arm **32** through the extraction slot **62** to further move the film segment **56** in conjunction with the rollers **36** out of the slide mount **48**. Steps **104** and **106** may be performed repeatedly for a plurality of film perforations until the film segment **56** is substantially or completely extracted from the cavity **54**.

Steps **88–106** may be timed such that movement of extractor arm **32** and the film segment **56** is controlled to match a predetermined constant spacing between the perforations **68–72** of the film segment **56**, such that repeated motions of the extractor arm **32** as described above coincide with the positions of the perforations to ensure engagement of the extractor arm **32** with the perforations. Alternatively, the extractor arm **32** may slidably engage the film segment **56** and rely on gravity and/or a force along the z-axis provided by the extractor motor **24** to push the extractor arm **32** into a perforation passing thereunder. In addition, the various steps **88–106** shown in FIG. **10** may be executed by the processor **12** to repeatedly loop in a set of operating cycles for cyclically operating the solenoid **22** and the solenoid piston **30** thereof, for cyclically operating the extractor arm **32**, for cyclically operating the slide positioner **34**, for cyclically operating the rollers **36**, and optionally for cyclically operating the magnetic writing head **66**. Such cyclic operation of the various components of the disclosed film extraction system **10** may implement an automated, high speed film handling system with high accuracy.

While the disclosed film extraction system and slide for use therewith, and the disclosed film extraction method are particularly shown and described herein with reference to the preferred embodiments, it is to be understood that various modifications in form and detail may be made without departing from the scope and spirit of the present invention.

For example, the cavity **54** may be formed by indentations in only the first portion **50**, only the second portion **52**, or both the first portion **50** and the second portion **52**. In addition, the cavity **54** may extend from the edge closest to the rollers **36** to at least a location in the interior of at least the first portion **50** and the second portion **52**; that is, the cavity **54** extends from one side of the slide **46** but may or may not extend completely to the other side of the slide **46**.

Further, the locking aperture **60** may be formed in only the first portion **50**, only the second portion **52**, or both the first portion **50** and the second portion **52**; that is, the locking aperture **60** may or may not extend through the entire slide **46**. In addition, the locking aperture **60** may be positioned on the same side of the slide **46** as the extraction slot **62**, or may be positioned on a different side, such as on the opposite face of the slide **46**. In addition, the cut-out region **58** may be formed from the first portion **50**, from the second portion **52**, or from both the first portion **50** and the second portion **52** as shown in FIG. **2**. Alternatively, the slide positioner **34** may engage a structure attached to the slide **46** separate from the first portion **50** and the second portion **52** for positioning the slide **46**.

In addition, the latch mechanism, including the resilient member **80**, may be formed from or attached to the first portion **50** and/or the second portion **52**. Alternatively, the resilient member **80** may be formed from or attached to the first portion **50** but may be positioned in a latch indentation in the second portion **52**. Further, the slot recess **82** and/or the ramp **84** may be formed in the first portion **50** and/or the second portion **52**. Further, the embodiments shown in FIGS. **3** and **4** may be combined to use at least one protrusion **74** and at least one latch end **76** with at least one resilient member **80** to secure the film segment **56** in the cavity **54** by frictional resistance which may be overcome by the motion of the extractor arm **32**.

The invention has been described in detail with particular reference to certain preferred embodiments thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention.

PARTS LIST

10 film extraction system
12 processor
14 solenoid driver
16 extractor driver
18 slide driver
20 roller driver
22 solenoid
24 extractor motor
26 slide motor
28 roller motor
30 solenoid piston
32 extractor arm
34 slide positioner
36 roller
38 transistor
40 node to energy source
42 resistor
44 ground
46 slide
48 slide mount
50 first portion
52 second portion
54 cavity
56 film segment
58 cut-out region
60 locking aperture
62 extraction slot
64 axles
66 magnetic writing head
68 first perforation
70 third perforation
72 second perforation
74 protrusion
76 latch end
78 latch indentation
80 resilient member
82 slot recess
84 ramp
86 end of film segment
88 generate control signals
90 move slide
92 activate solenoid
94 disengage latch
96 extend extractor
98 engage perforation
100 move extractor arm
102 engage film segment
104 engage perforation
106 move extractor arm

What is claimed is:

1. A film extraction system for extracting a film segment from a slide mount, the slide mount having a cavity, a locking aperture, a latch mechanism securely engaging the film segment in the cavity, and a slot extending from an interior region to an edge of the slide mount, the film extraction system comprising:

a piston for contacting the latch mechanism to disengage the latch mechanism from the film segment; and

an extractor arm for entering the slot to engage a perforation in the film segment, and for slidably moving within the slot to move the film segment through the cavity in the direction of the edge of the slide mount to exit the cavity.

2. The film extraction system of claim **1** further comprising:

a processor for generating control signals sequentially to cause the piston to disengage the latch mechanism, to cause the extractor arm to engage the perforation, and to cause the extractor arm to slidably move within the slot.

3. The film extraction system of claim **2** further comprising:

a solenoid for extending the piston to contact the latch mechanism; and

a solenoid driver, responsive to the control signals from the processor, for causing the solenoid to extend the piston.

4. The film extraction system of claim **2** further comprising:

an extractor motor for moving the extractor arm in a first direction to enter the slot, and for moving the extractor arm in a second direction to slidably move within the slot; and

an extractor driver, responsive to the control signals from the processor, for causing the movement of the extractor arm in the first and second directions.

5. The film extraction system of claim **1** further comprising:

at least one roller adjacent to the slide mount for extracting the film segment therefrom.

6. The film extraction system of claim **5** further comprising:

a magnetic die located adjacent to the at least one roller;

wherein the extracted film segment has magnetic material thereon which passes adjacent to the magnetic device when the at least one roller passes a predetermined portion of the extracted film segment adjacent to the magnetic device.

7. The film extraction system of claim **5** further comprising:

a slide positioner for engaging the slide mount to position the edge of the slide mount adjacent to the roller.

8. A method for extracting a film segment from a slide mount comprising the steps of:

(a) extending a piston into a locking aperture in the slide mount;

(b) disengaging a latch end from a first perforation in the film segment;

(c) extending the extractor arm into the extraction slot in the slide mount;

(d) engaging a second perforation in the film segment with the extractor arm; and

(e) moving the extractor arm through the extraction slot to extract the film segment out of the slide mount.

9. The method of claim **8** further comprising the steps of:

generating control signals using a processor to control the piston and the extractor arm.

10. The method of claim **8** further comprising, before step (a), the step of:

(a1) moving the slide mount using a slide positioner to a position to be engaged by the piston and the extractor arm.

11. The method of claim **10** wherein the step (a1) of moving the slide mount includes the step of:

(a2) moving the slide mount using a slide positioner to a position adjacent to at least one roller.

12. The method of claim **11** further comprises, after step (e), the step of:

(f) engaging the film segment with the roller to further extract the film segment from the slide mount.

13. The method of claim **8** further comprising, after step (e), the steps of:

(f) engaging at least a third film perforation in the film segment with the extractor arm; and

(g) moving the extractor arm through the extraction slot to further extract the film segment.

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